

## CLAIMS

I claim:

- 5           1.     A fuel cell assembly, comprising:  
              a housing having an outer region and an inner region defining a  
perimeter; and  
              at least one fuel cell shaped to define at least one reactant path which  
extends at least once around the perimeter of the inner region and has an upstream  
10 end associated with the outer region and a downstream end associated with the  
inner region.
2.     A fuel cell assembly as claimed in claim 1, wherein the housing  
includes at least one housing inlet associated with the upstream end of the at least  
15 one reactant path and at least one exhaust port operably connected to the  
downstream end of the at least one reactant path.
3.     A fuel cell assembly as claimed in claim 1, wherein the at least one  
fuel cell comprises first and second fuel cells, and the at least one reactant path  
20 comprises fuel and oxidant paths that each extend at least once around the  
perimeter of the inner region and have respective upstream ends associated with  
the outer region and downstream ends associated with the inner region.
4.     A fuel cell assembly as claimed in claim 3, wherein the housing  
25 includes a fuel inlet associated with the upstream end of the fuel path and an  
oxidant inlet associated with the upstream end of the oxidant path.
5.     A fuel cell assembly as claimed in claim 1, wherein the reactant path  
extends more than once around the perimeter of the inner region of the housing.

6. A fuel cell assembly as claimed in claim 1, wherein the reactant path extends at least a plurality of times around the perimeter of the inner region of the housing.

5 7. A fuel cell assembly as claimed in claim 1, further comprising:  
a byproduct outlet tube associated with the inner region of the housing.

8. A fuel cell assembly as claimed in claim 7, wherein the byproduct  
10 outlet tube is gas permeable.

9. A fuel cell assembly as claimed in claim 7, wherein the at least one reactant path extends at least once around the byproduct outlet tube.

15 10. A fuel cell assembly as claimed in claim 1, wherein the housing includes an exhaust port operably connected to the inner region, the fuel cell assembly further comprising:  
a heat exchanger associated with the housing and operably connected to the exhaust port.

20 11. A fuel cell assembly as claimed in claim 1, further comprising:  
at least one reactant supply operably connected to the upstream end of the at least one reactant path.

25 12. A fuel cell assembly as claimed in claim 1, wherein the reactant path defines a spiral shape.

13. A fuel cell assembly as claimed in claim 12, wherein the reactant path defines a substantially curvilinear spiral shape.

30 14. A fuel cell, comprising:  
an exhaust region defining a perimeter; and

at least one anode and cathode arrangement having a spiral shape that extends more than once around the perimeter of the exhaust region and defines a reactant path having an outlet end associated with the exhaust region and an inlet end.

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15. A fuel cell as claimed in claim 14, further comprising:  
a byproduct outlet tube that defines the exhaust region.

16. A fuel cell as claimed in claim 14, wherein the exhaust region is  
10 defined by a portion of the at least one anode and cathode arrangement.

17. A fuel cell as claimed in claim 14, wherein the at least one anode and cathode arrangement comprises first and second anode and cathode arrangements that define substantially coextensive spiral shapes.

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18. A fuel cell as claimed in claim 14, wherein the at least one anode and cathode arrangement comprises an anode, a cathode and an electrolyte.

19. A fuel cell assembly, comprising:  
20 a housing having an outer region and an inner region defining a perimeter; and

- means for converting reactants into electricity and byproducts and directing the reactants and byproducts from the outer region to the inner region, and at least once around the perimeter of the inner region, as the reactants are being  
25 converted into electricity and byproducts.

20. A fuel cell assembly as claimed in claim 19, wherein the housing includes an exhaust port operably connected to the inner region.

- 30 21. A fuel cell assembly as claimed in claim 20, further comprising:  
a heat exchanger associated with the housing and operably connected to the exhaust port.

22. A fuel cell assembly as claimed in claim 19, wherein the housing includes a fuel inlet associated with the outer region and an oxidant inlet associated with the outer region.

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23. A fuel cell assembly as claimed in claim 19, further comprising:  
at least one reactant supply operably connected to the means for converting reactants into electricity and byproducts.

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24. A method of making a fuel cell, comprising:  
providing at least one fuel cell sheet;  
bending the at least one fuel cell sheet into a spiral shape that defines a reactant path between adjacent portions of the at least one fuel cell sheet; and  
fixing the at least one fuel cell sheet in the spiral shape.

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25. A method as claimed in claim 24, wherein the step of providing at least one fuel cell sheet comprises providing first and second fuel cell sheets.

26. A method as claimed in claim 25, further comprising the steps of:  
20 providing a byproduct outlet tube; and  
securing the first and second fuel cell sheets to respective portions of the byproduct outlet tube.

27. A method as claimed in claim 25, wherein the step of bending the at  
25 least one fuel cell sheet comprises bending the first and second fuel cell sheets into respective and substantially coextensive spirals that define fuel and oxidant paths therebetween.

28. A method as claimed in claim 24, wherein the step of bending the at  
30 least one fuel cell sheet comprises bending the at least one fuel cell sheet into a spiral shape that defines fuel and oxidant paths between adjacent portions of the at least one fuel cell sheet.

29. A method as claimed in claim 28, further comprising the step of:  
forming a byproduct outlet region with a portion of the at least one fuel  
cell sheet.

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30. A method as claimed in claim 24, wherein the step of fixing the at  
least one fuel cell sheet in the spiral shape comprises firing the at least one fuel cell  
sheet.

10 31. A method of operating a fuel cell having an inner region defining a  
perimeter and an outer region, the method comprising the step of:

directing reactants from the outer region to the inner region and at  
least once around the perimeter of the inner region as the reactants travel from the  
outer region to the inner region; and

15 consuming at least a portion of the reactants as the reactants travel  
from the outer region to the inner region.

32. A method as claimed in claim 31, wherein the step of directing  
reactants from the outer region to the inner region comprises directing reactants  
20 along a spiral shaped reactant path that extends from the outer region to the inner  
region and at least once around the perimeter.

33. A method as claimed in claim 31, wherein the step of directing  
reactants from the outer region to the inner region comprises directing reactants  
25 along a spiral shaped reactant path that extends from the outer region to the inner  
region and more than once around the perimeter.

34. A method as claimed in claim 31, wherein the step of directing  
reactants from the outer region to the inner region comprises directing fuel through  
30 a fuel path that extends from the outer region to the inner region and at least once  
around the perimeter of the inner region and directing oxidant through an oxidant

path that extends from the outer region to the inner region and at least once around the perimeter of the inner region.

35. A method as claimed in claim 31, wherein the step of consuming at least a portion of the reactants comprises consuming at least a portion of the reactants and generating heated byproduct as the reactants travel from the outer region to the inner region, the method further comprising the step of:

directing the heated byproduct to a heat exchanger associated with the fuel cell.

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36. A method as claimed in claim 31, wherein the step of consuming at least a portion of the reactants comprises consuming at least a portion of the reactants and generating heated byproduct as the reactants travel from the outer region to the inner region, the method further comprising the step of:

15 directing the heated byproduct out of the fuel cell along the longitudinal axis.

37. An apparatus, comprising:

a power consuming device; and

20 a fuel cell assembly including

a housing having an outer region and an inner region defining a perimeter, and

25 at least one fuel cell, operably connected to the power consuming device, shaped to define at least one reactant path which extends at least once around the perimeter of the inner region and has an upstream end associated with the outer region and a downstream end associated with the inner region.

38. An apparatus as claimed in claim 37, wherein the at least one fuel cell comprises first and second fuel cells, and the at least one reactant path comprises fuel and oxidant paths that extend at least once around the perimeter of the inner

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region and have respective upstream ends associated with the outer region and downstream ends associated with the inner region.

39. An apparatus as claimed in claim 37, wherein the reactant path  
5 extends more than once around the inner region of the housing.

40. An apparatus as claimed in claim 37, wherein the reactant path extends at least a plurality of times around the inner region of the housing.

10 41. An apparatus as claimed in claim 37, wherein the housing includes an exhaust port operably connected to the inner region, the fuel cell assembly further comprising:

a heat exchanger associated with the housing and operably connected to the exhaust port.

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42. An apparatus as claimed in claim 37, further comprising:  
at least one reactant supply operably connected to the upstream end of the at least one reactant path.